GEI-18800B

INSTRUCTION BOOK

FOR

MAGNETIC WIRE RECORDER

MODEL 20N-1

ELECTRONICS DEPARTMENT
BRIDGEPORT, CONN.

108

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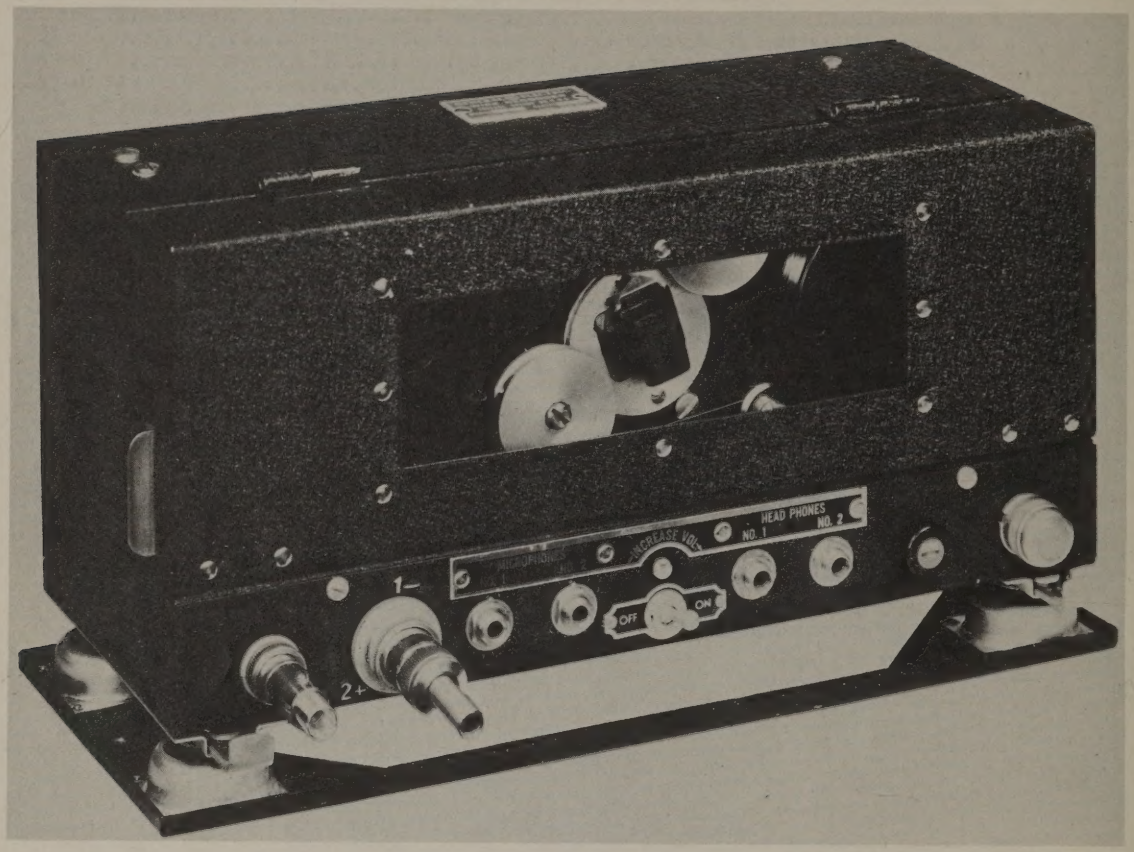

Fig. 1. Wire Recorder Model 20 N-1 with accessories

SECTION I. DESCRIPTION

A. GENERAL

The Model 20 N-1 Recorder is a wire-recording device designed for operating on a nominal 28 volt d-c power source. The unit functions primarily as a recording device but it may also serve as a two-station inter-phone system. A standard one-half pound spool of recording wire will record all communications over the inter-phone system for a net period of 66 minutes. Since the electric motor, which transports the recording wire through the mechanism, operates only when the push-to-talk button on either microphone is depressed, the elapsed operational time for a spool of wire will be considerably greater than the net period. Recordings made on the Model 20 N-1 Wire Recorder may be played back on the associated Model 50 Equipment.

The unit is composed of a recording mechanism, a base plate with shock mounts, an audio amplifier, a 30 kc oscillator, a driving motor, and accessories. The recording mechanism consists of a recording head, and a wire transporting mechanism. The output of the audio amplifier is connected in series with the oscillator transformer to the coil in the recording head. The recording head is a sensitive device which impresses the amplified audio signal onto a spool of magnetic recording wire which runs through a groove in the head. The driving motor moves the wire through the wire guide pulleys and the recording head onto the take-up spool. The wire and spools are included in the accessories for the recorder. For full details of the list of accessories, consult "B. Component Parts and Accessories".

B. COMPONENT PARTS AND ACCESSORIES

1. COMPONENT PARTS

Two - Type 28D7 tubes
One - 5.0 amp. fuse
One - Protective cover of black, crackle-finish steel with separable hinges
One - Shock mount base

2. ACCESSORIES FURNISHED

One - Empty spool for holding recording wire
One - Spool with approx. 1/2 lb. (11,500 ft.), 4 mil, medium carbon steel, recording wire
One - Spare 5.0 amp. fuse
One - Tube of lubricant suitable for application on the gears (medium grease)
One - Amphenol MC2M two-contact male connector
One - Amphenol MC3F three-contact female connector

3. ACCESSORIES REQUIRED (NOT FURNISHED)

One - Carbon microphone, Type NAF 213264-6 (RS38-A, made by Telephonics Corp., New York, N. Y.) with 6 feet of three-conductor cord and tip, ring and sleeve plug (N.A.F. No. 212938-1). This microphone has a push-to-talk switch on the top of the microphone case. The switch will make and break both the microphone circuit and the motor relay circuit. If any other length of cable is desired, this must be definitely specified in the order.

One - Headset, Navy Type No. 49015 (Type TH37-A, Telephonics Corp., New York, N. Y.) with an impedance of 300 ohms.

One - Six-foot power cord. No battery clips are provided on the battery end of the cord. The 3-prong connector for the other end is furnished with the unit. If any other cable length is desired, this must be definitely specified in the order.

One - Toggle switch cable with Amphenol MC2M, two-prong male connector. This cable provides means for controlling the unit if a microphone with no push-to-talk switch is used. The length of cable must be specified in the order. The connector is furnished with the unit but no cable is supplied.

In addition, batteries for the 28 volts d-c power supply and the battery clips for the end of the power cord must be furnished.

C. ELECTRICAL SPECIFICATIONS

Power	24 v. d-c min. to 30 v. d-c max.
Oscillator Frequency	24 to 30 kc
Current Drain	2.8 amps. max.
Spool Rotation	200 rpm ± 6%

D. DIMENSIONS AND WEIGHTS

1. DIMENSIONS OF UNIT AND COVER, EXCLUSIVE OF ACCESSORIES:

	Cabinet	Cover
Width (excluding the handles)	12 3/4 inches	12 3/4 inches
Height (exclusive of shock mount and hinges)	5 27/32 inches	4 3/16 inches
Depth (excluding panel indicators and shock mounts)	5 3/4 inches	1 11/16 inches

2. TOTAL WEIGHT OF UNIT AND COVER, EXCLUSIVE OF ACCESSORIES AND SHOCK MOUNTS:

Approx. 12 3/4 pounds.

E. TUBE COMPLEMENT

1 - Type 28D7, used as V101, push-pull amplifier
1 - Type 28D7, used as V102, oscillator

F. CONSTRUCTION

The Recorder, Model 20 N-1, lends itself readily to servicing because of the ease with which the unit can be disassembled. The back cover can be removed with the use of a screwdriver. After it is removed, the tubes are accessible. By removing the two screws at the lower front panel and four screws from the bottom cover of tne unit, the electrical chassis can be separated from the unit, thus completely exposing the back portion of the recording mechanism. The chassis contains all electrical components except the filter, motor, etc. (see Fig. 6). In back of the recording mechanism is found the motor, drive gear and spool gear assemblies, and the recording head and wire guide (see Figs. 3 and 5). An inter-electric connection is provided for the chassis and recording mechanism by jack J103 and plug P103 (see Fig. 4).

The control panel is located at the front of the unit (see Fig. 2). The lower portion of the panel contains all operating sockets and electrical controls. These include a power socket, a socket for the motor starting switch, two microphone jacks, an ON-OFF switch, a gain control, two headphone jacks, a fuse, and a pilot light. On the upper recessed portion are mounted the supply and take-up spools, the guide pulleys, and the recording head.

The drive shaft of the take-up spool is coupled to the motor by means of a worm gear. The worm is keyed to the motor output shaft, and the associated gear is keyed to the shaft of the take-up spool. The worm and gear is intragal with the motor housing.

By means of a reversing screw arrangement behind the upper panel--guide pulley #3 slides in and out during the recording period (see Fig. 2). Since the wire passes over the guide pulley, it is wound evenly on the take-up spool. The correct speed ratio is maintained between the reversing screw and the output shaft of the motor by means of a gear train (see Fig. 3).

SECTION II. FUNCTIONING OF ELECTRICAL PARTS

A. AMPLIFIER CIRCUIT

Reference for this discussion is the schematic diagram, Fig. 7.

The Recorder Unit is equipped with two (telephone type) microphone input jacks J104 and J105, connected to the primary of the input transformer T101. Either one or both input jacks may be used, thus providing for recording from two sources. The microphone plugged into jack J104 couples to the upper half of the input transformer primary (terminals 2 and 3), and the microphone plugged into jack J105 couples to the lower half of the input transformer primary (terminals 1 and 2). See heading "C" for discussion of microphone connections.

The secondary winding of the input transformer feeds to the control grids of the (Type 28D7) V101 tube, which operates as a push-pull amplifier. R101 is the volume control potentiometer (screwdriver-adjusted from the front of the unit), and controls the input level of the signal by varying the load across the input transformer secondary. Bias for the two grids is supplied at the T101 secondary center tap (terminal 5). The bias source is described under the heading "B - Oscillator Circuit". The suppressor grids and cathodes are connected internally, and grounded. The two screen grids are also connected internally, and are supplied with plus 28 volts d-c at pin No. 3. The plus 28 volts d-c is also applied to the center tap (terminal No. 2) of the output transformer primary, thereby supplying plate voltage to the two plates. The output is tapped off the secondary of the output transformer, T102, and applied to the rings of the two audio output phone jacks J106 and J107. The sleeves of the two output jacks and the lower end (terminal No. 4) of the T102 output transformer secondary are grounded, which completes the circuit. See heading D for discussion of the earphones connections. Simultaneously, the audio output is applied through R104 and the pick-up coil of the oscillator coil T103, and through terminals No. 4 on J103 and P103 to the recording head. The other end of the recording head coil is grounded through terminals No. 5 on P103 and J103. The network composed of R104, C102, and R110, serves a dual purpose. The circuit resonates at such a frequency that the "highs" in the voice range are accentuated; also this network isolates the high-frequency voltage from the audio amplifier. The pilot lamp, I101, for which R111 is the voltage dropping resistor, is illuminated when the amplifier circuit is energized.

B. OSCILLATOR CIRCUIT

The second Type 28D7 tube, V102, with the oscillator coil, T103, operates as a 30 kc oscillator. The imposition of this 30 kc on the recording wire controls the magnetization of the wire so as to eliminate amplitude distortion of the audio signal that otherwise results. The 30 kc is not recorded on the wire, however, and cannot be reproduced.

V102 is operated in a conventional Hartley-type oscillator circuit, with B plus applied to a tap on the oscillator coil, and C103 being the capacity element of the tuned circuit. Capacitor C105 is a blocking capacitor to keep B plus from the grid. Grid bias for the oscillator is provided by the voltage drop across the bias resistors R105 and R106. The bias developed is approximately 6 volts. Bias for the V101 amplifier tube is taken off at the junction between resistors, R105 and R106. Since these two resistors are of equal magnitude, the bias supplied to V101 (through the center tap of the input transformer secondary) is one half of 6 volts, or 3 volts. The condenser, C106, acts as a filter so that the bias voltage is free from ripple. The condenser C104 by-passed the B+ thus preventnng any small fluctuations in voltage from affecting the oscillator circuit. This condenser also prevents feed-back into the power supply from the oscillator.

C. MICROPHONE CONNECTIONS

The switch on the RS38-A type of microphone is a double contact push-button type switch, used to close the microphone and motor relay circuits. The microphone is a single button carbon microphone, one side of which is connected directly to the sleeve of the plug, and the other side connected through the switch microphone contacts to the ring of the plug.

The motor relay contacts connect between the plug sleeve and plug tip.

Referring to the schematic diagram, Fig. 7. the microphone connections are made through the sleeve and ring of the microphone input jack. The sleeve is grounded and the ring connects to one end of the input transformer (T101) primary. Condensers C107 and C108, connected to the ends of the primary of the input transformer (T101), are provided to by-pass r-f which might be picked up by the microphone cable. The center tap of the input transformer primary connects to the junction between resistors R102 and R103, which serve as a voltage dividing network across the plus 28 volt supply to provide d-c voltage for the carbon microphone. The voltage dividing resistors are of such value as to apply approximately 5.5 volts d-c to the microphone when the switch button is depressed. Thus, when the push-to-talk button is depressed, the microphone circuit follows from ground, through the microphone, switch, one half of the input transformer primary, a 5.5 volt d-c supply, and back to ground again.

The motor relay coil, L101, has 28 volts d-c supplied to one side. The circuit is completed either through 1 to 2 on J101 or from the tip of J104 or J105 to the sleeve which is grounded. The microphone push-to-talk circuit completes the circuit in J104 or J105. The auxiliary microphone switch, which may be plugged into J101 can be used to complete the motor relay circuit if a push-to-talk switch is not incorporated in the microphone.

D. EARPHONE CONNECTIONS

Two audio output headphone jacks are provided (J106 and J107) which are connected across the output transformer (T102) secondary. The sleeves of the jacks connect through ground to the lower end of the output transformer secondary, and the jack tips connect onto either taps Nos. 5 or 6 through resistor R112. The output transformer secondary has two taps in addition to the ground connection, so that a choice of two different impedance headphones may be used. The impedance across terminal 6 to 4 is 2,000 ohms, and across terminal 5 to 4 is 150 ohms. The units are wired when shipped from the factory for use with 300 ohm headphones, i.e., the phone jack tips are connected to tap No. 5 which is the 150 ohm impedance matching connection. When a set of headphones is plugged in, the terminating resistor is automatically cut out of the circuit by the plug, and the resistance is replaced by the impedance of the earphones. Thus the headphones used should have an impedance of 300 ohms each so that either 2 sets of headphones in parallel, or one set of earphones and one 800-ohm terminating resistor in parallel, provide the proper load across the output transformer secondary.

The unit is provided with an extra pair of 4000-ohm resistors so that it be desired to use 4000-ohm earphones, the 800-ohm resistors, R107 and R108, may be replaced by the 4000-ohm resistors, R113 and R114, and the lead now connected to terminal 5 on the output transformer (T102) changed to terminal 6. Thus the load on the output transformer is maintained at approximately 2000 ohms.

E. MOTOR

The schematic for the motor section is shown in Fig. 7, as connected to plug, P103. M101 is the 28 volt d-c series field motor which drives the take-up spool mechanism. The motor governor is paralleled by resistors R109 and R115 and used to maintain constant motor speed. The filter circuit composed of L102, C109, and C110, together with the shield covering R109 and R115 suppresses noise of radio frequency which radiates from the motor and governor and prevents it from interfering with radio communication.

Plus 28 volts d-c for the motor field is applied through the relay contacts and pin No. 2 of plug P103 from the ON-OFF switch, S101. Ground return for the motor is through pin No. 1. When the motor relay, L101, is energized, the contact arm moves in and applies 28 volts to the motor field. The motor drives only for the period during which the relay, L101, is energized--which is controlled by the push-to-talk switch on the microphone.

The governor attempts to maintain constant motor speed by varying the voltage to it as its speed changes. The governor consists of a split brass disc directly coupled to the motor shaft so that it rotates synchronously with the motor armature. The two sets of the disc are connected through a set of contact points, so that under conditions of low speed, the resistors R109 and R115 are directly shorted out. Should the motor speed increase beyond normal, the contact points open, which puts the dropping resistors R109 and R115 in series with the line, reducing the voltage applied to the motor, thus reducing the motor speed to its desired level.

F. POWER SWITCH AND FILAMENT SUPPLY

The ON-OFF switch, S101, is a S.P.S.T. switch connected in series with plus 28 volts d-c supply and is the main power switch for the unit.

The tubes have 28 volt filaments which are connected directly across the 28 volt supply. Resistor R103 and capacitor C101 form a filter for the d-c supply to the carbon button microphone. Resistors R103 and R102 are a voltage dividing network which taps off approximately 5.5 volts d-c for the microphone operation.

Fuse F101 functions for all components of the unit.

G. SWITCH PLUG CONNECTIONS

Jack J101 is a 2-pin jack that may be used to operate the motor circuit. This may be used in place of, or in addition to, the motor switch in the microphone handle. In order to duplicate the operation of the motor relay switch in the push-to-talk switch, a single-pole-single-throw switch may be connected across pins 1 and 2 in jack J101. This would ground the tip of the microphone input jack and repeat the operation of the motor relay contacts in the push-to-talk microphone switch as described under the heading "C. Microphone Connections".

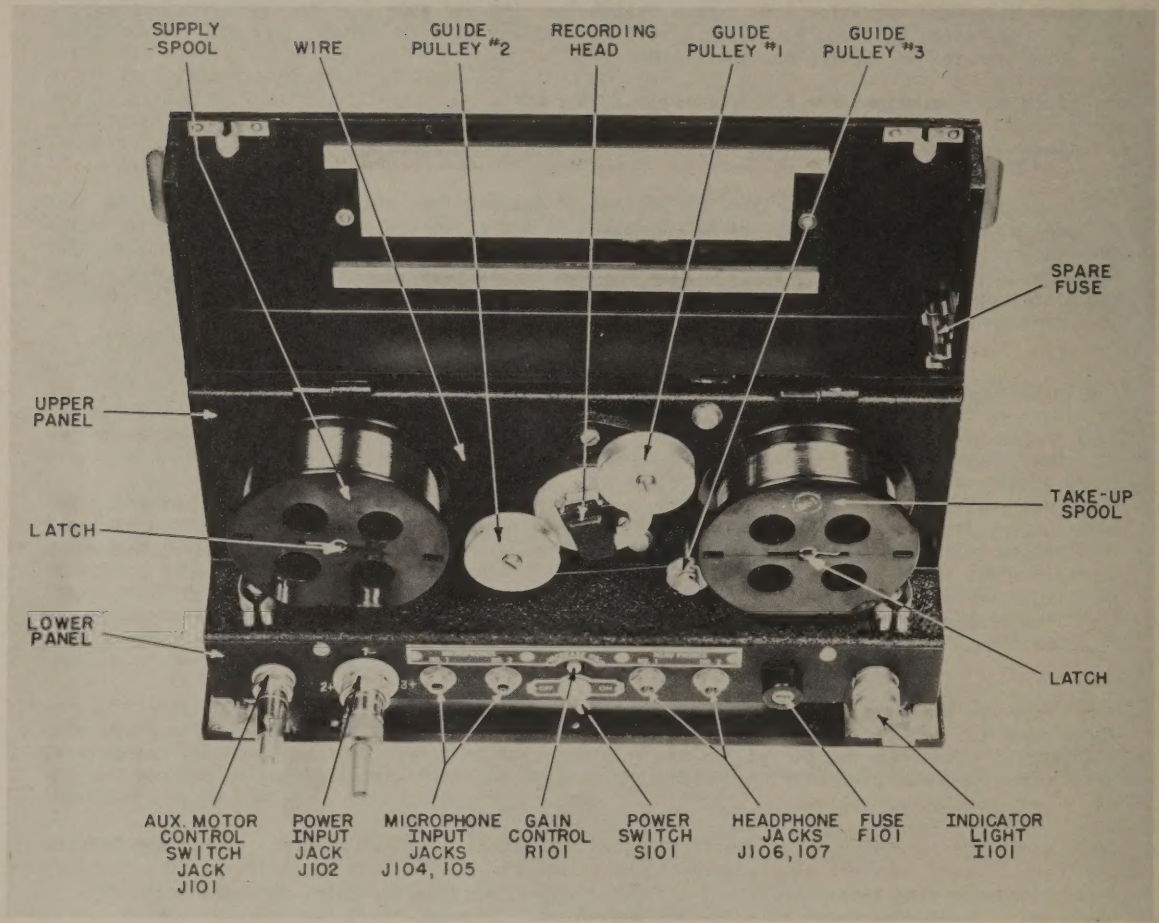

Fig. 2. Front View—Cover Removed—Showing Control Panel and Spools

SECTION III. EMPLOYMENT

A. INSTALLATION

1. GENERAL CONSIDERATIONS

In choosing the mounting location for Recorder Model 20 N-1, allow sufficient clearance for removing the protective cover and for removing the unit from the base plate. At least one-half inch clearance should be allowed at the back of the case to permit free action of the shock mounts. In order to make the electrical installation, batteries and battery clips will have to be provided (see the heading "Accessories Required" under Section I, B). For orientation purposes, pin number 1 at jack J102 (see Fig. 2) is negative and pins 2 and 3 are positive. See the schematic diagram, Fig. 7.

2. SET-UP OF RECORDER AND PREPARATION FOR USE

Refer to the heading "Accessories Required" under Section 1-B for cable lengths. The length of each cable will aid in selecting a location for the unit.

To set up the equipment, use the following installation procedure:

a. Open the hood of the protective cover.

b. Place the (loaded) supply spool on the left-hand shaft, with the wire feeding off the top, and the take-up spool on the right-hand shaft, (see Fig. 2).

c. To thread, take the wire from the top of the supply spool and thread it around guide pulley #1, across the top of recording head, around pulley #2, over the top of small guide pulley #3 (at the left of the take-up spool) and then to the bottom of the take-up spool as shown in Fig. 2. The wire should lie tangent across the bottom of pulley #1 and the top of pulley #2 and across the bottom of pulley #2 and the top of pulley #3. The wire must also lie in the bottom of the groove of the recording head for proper operation. When this is the case, the cover flap for the recording head will close completely.

d. Pass the wire along the bottom of the take-up spool and with Scotch tape fasten it to the shank of the spool in order to prevent slipping. The take-up spool rotates counterclockwise. Turn the right-hand spool in a counterclockwise direction by hand for several turns to make sure that the wire is firmly attached to the spool and to see whether the left-hand spool follows.

e. Close the latches of the spools to lock the spools to their shafts. After the latches are closed, any excess slack can be taken up by rotating the supply spool in a counterclockwise direction.

f. Connect the power cord plug at jack J102; the microphone plug at jacks J104 or J105; and the headset plug at jacks J106 or J107. For orientation, refer to Fig. 2. Provision is made for 2 microphones and 2 headphones so that two persons may use the equipment simultaneously.

g. Turn the OFF-ON switch, S101, to ON. This switch is connected to the 28 volt d-c power supply and controls all power to the unit.

B. OPERATION

The recording operation is as follows:

1. Turn the OFF-ON switch ON. Approximately thirty seconds will elapse before the tubes reach the proper temperature.

2. Press the push-to-talk switch on the microphone. By pressing the switch button down completely, the motor relay circuit is energized. This places the recording system in use. The pilot light, I101, is illuminated when the amplifier circuit is energized.

The motor also can be controlled by the toggle switch and cord listed among the accessories. This arrangement connects to jack J101 and is used when no push-to-talk button is available with the microphone. This switch performs the same function as the push-to-talk switch on the microphone with the exception that the microphone circuit is energized all the time that the OFF-ON switch is ON.

3. Allow about 6 feet of wire to wind onto the take-up spool to complete the thread-up operation.

4. Begin recording. Hold the microphone about one inch away from the lips and use a normal voice level.

5. The volume control is located just above the OFF-ON switch and may be adjusted with a screwdriver. The normal operating position is about 1/3 turn clockwise.

6. The unit records for a period of approximately 60 minutes. Record up to the last 1 to 2 feet of wire, reserving this length of wire for threading onto the reproducing machine.

7. To stop, simply release the push-to-talk switch.

Before reproduction of the recording can be made, rewind the newly loaded spool on a reproducing machine. For reproduction, the recording must be fed in the same direction as initially fed onto the recording spool. Special instructions for this procedure are given in a separate instruction book pertaining to the 50--series recording--reproducing machines.

SECTION IV. MAINTENANCE

A. LUBRICATION AND SERVICING

Worm gear, traverse screw and spur gear train should be lubricated after approximately 200 hours of use with a light film of Beacon M285, low temperature grease or equivalent. All bearings are Olite bearings and, if at any time they should need additional lubrication, a light grade of machine oil should be used. The motor is lubricated for the life of the machine and need not be disturbed.

The worm gear can be easily lubricated by removing retaining ring and gear housing cover plate. See Fig. 5.

The recording wire is coated with a rust-preventing grease. The grease on the wire is perfectly normal and should be left on the wire.

The recording head should be cleaned from time to time, whenever the recordings sound weak and muffled. As a suggestion, the slot can be cleaned with a piece of stiff paper, such as cardboard, especially if excess grease from the wire accumulates. Avoid denting and scratching the slot with a sharp instrument.

If it becomes necessary to clean the governor contacts, use a soft cloth for this purpose.

B. WIRE-SPLICING

To splice a wire, anneal the ends of the wire with a soldering iron or, in an emergency only, with a lighted cigarette. After the wire has been annealed, tie the broken ends together in a small, neat knot. The knot should be small enough to pass through the groove in the recording head. It is desirable to reheat the finished knot after the tying process to relieve the internal strains caused by knotting. The free ends should be trimmed off so that they project no more than 1/16 inch. Test the splice by running it through the recording head, turning first one spool, then the other by hand. The recording head is designed so that a splice in the wire will lift itself out of the slot.

C. SOCKET VOLTAGES

The following voltages are measured with a 20,000 ohms-per-voltmeter between the respective pins and ground.

V101, Type 28D7, Amplifier

	Nominal
Plates (Pins 4 and 5)	28 volts d-c
Screens (Pin 3)	28 volts d-c
Filament (Pin 8)	28 volts d-c
Grid Bias (Pins 2 and 7)	-3 volts
Cathodes and Suppressors (Pin 6)	ground (0 volts)

V102, Type 28D7, Oscillator

	Nominal
Plates (Pins 4 and 5)	28 volts d-c
Screens (Pin 3)	28 volts d-c
Filament (Pin 8)	28 volts d-c
Grid Bias (Pins 2 and 7)	-6 volts
Cathodes and Suppressors (Pin 6)	ground (0 volts)

D. FUSE AND PILOT LIGHT REPLACEMENT

Fuse F101 may be removed with the aid of a screwdriver. The fuse cartridge is located at the front panel. A spare fuse is mounted on the inside of the protective cover hood. See Fig. 2.

The indicator light bulb is removed by unscrewing the jewel and disengaging the bulb from the socket. The bulb is the bayonette type and is disengaged by pressing it in and making a fraction of a turn to the left.

E. REPLACEMENT OF THE MOTOR BRUSHES

In order to change the brushes of the motor, it is first necessary to remove the back cover and the electrical chassis as described in Section II-F. The next step is to remove the 3 screws holding the motor assembly to the main frame of the unit. Once this motor assembly is free, the brushes may be removed and changed by unscrewing the brush caps on either side of the motor.

TABLE I—PARTS LISTS FOR THE 20 N-1 WIRE RECORDER

Symbol Designation	Function	Description	Mfgr.	Mfgr.'s Designation	G.E. Dwg. and Part No.
		CAPACITORS			
C101	Filter Condenser (for Mike Excitation Supply)	100 mf, 25 v., electrolytic	1	WBR	K56J826
C102	Filter Condenser	.003 mf, 600 v., oil	31	Type A7307	K56J780-3
C103	Tank Capacitor	.015 mf, 600 v., oil	31	Type A7789	K56J780-1
C104	By-Pass Condenser	.05 mf, 200 v., oil	31	Type A7781	K56J780-2
C105	Blocking Capacitor	.01 mf, 600 v., oil	31	Type A7314	K56J780-4
C106	Filter Condenser	Same as C104			
C107	R-F By-Pass Condenser	Same as C105			
C108	R-F By-Pass Condenser	Same as C105			
C109	Noise Filter	.01 mf, 400 v., paper wax filled (part of Noise Filter)			
C110	Noise Filter	.5 mf, 120 v., paper wax filled (part of Noise Filter)			
C111	Motor Filter Capacitor	2 X .1 mf +20%-10%, 600 v., paper, oil filled	31	PC68183C	K54J140-7
		ELECTRICAL ITEM			
E101	Recording Head	Case - Brass, Black Crackle Finish except mounting surface, Guard Flap Brass Chrome plated. D-C Coil Resistance 750 ohms, Coil Inductance 1.0 hys at 1000 cps	510	Per GE Dwg.	M55J400
		FUSES			
F101	Fuse	5 amp., 25 volts	153	#1080	DL4W493A-143
F102	Fuse (Spare)	Same as F101			
		JACKS AND RECEPTACLES			
J101	Motor Switch Connection	2 Pin Female	107	Type PC2F	K47J679-2
J102	Battery Input	3 Pin Male	107	Type PC3M	K56J661-2
J103	Motor Section Connection	8 Pin Connection	107	Type M1P8	K44J213
J104	Microphone Input	3 Contact	41	ST-917	K56J496
J105	Microphone Input	Same as J104			
J106	Headphone Jack	2 Contact - Normally Closed	41	IJ-102	K56J829
J107	Headphone Jack	Same as J106			
J108	Miniature Socket for Recording Head	Mat. Black Phenolic, 7 holes	107	#7879	K56J824
		INDICATOR			
I101	Power Indicator	6.8 v., 150 ma.	198	Mazda #47	DL4W493A-146
		COILS AND RELAYS			
L101	Motor Relay	S.P.S.T. N.O. Double break, Resistance 290 ohms, operating voltage 24 v. d-c	19	CR2791-B100AB	K56J600
L102	Filter Coil	#18HF Wire, 20 turns, solenoid, close wound. Part of Noise Filter.			

TABLE I—PARTS LIST FOR THE 20 N-I WIRE RECORDER (CONTINUED)

Symbol Designation	Function	Description	Mfgr.	Mfgr.'s Designation	G.E. Dwg. and Part No.
		MOTOR			
M101	Motor and Governor	Dumore, 28 volts, Series wound d-c Motor with Governor Motor lead Type with output speed of 200 r.p.m.± 3%, counterclockwise as viewed from shaft.	516		M55J511
		MECHANICAL PART			
0101	Supply Spool of Wire	1/2 lb. (11,500 ft.) of .004" Steel medium carbon wire on spool	605	Per GE DWg.	K52J852-G1
		PLUGS			
P101	Aux. Motor Switch Plug	2 Contact Connector (male plug)	107	MC2-M	K47J685-2
P102	Battery Input Plug	3 Contact Connector (female plug)	107	MC3-F	V53J644-2
P103	Motor Section Connection	8 Pin Plug	107	PM-8	K56J830
		RESISTORS			
R101	Vol. Control	.5 meg. Pot., carbon	8	Code No. 33-010-000	K56J662
R102	Voltage Divider	200 ohms± 5%, 1/2 w., carbon	28	Type BT-1/2	M31J707-142
R103	Voltage Divider	820 ohms±10%, 1 w., carbon insulated	28	Type BT-1	M31J708-61
R104	Filter Resistor	100,000 ohms±10%, 1/2 w., carbon insulated	28	Type BT-1/2	M31J707-86
R105	Grid Bias Resistor	24,000 ohms± 5%, 1/2 w., carbon insulated	28	Type BT-1/2	M31J707-192
R106	Grid Bias Resistor	Same as R105			
R107	Headphone Shunting Resistor	820 ohms±10%, 1/2 w., carbon insulated	28	Type BT-1/2	M31J707-61
R108	Headphone Shunting Resistor	Same as R107			
R109	Voltage Dropping Resistor	15 ohms±10%, 25 w., w.w.	59	Per GE Dwg.	K56J514-2
R110	Filter Resistor	Same as R104			
R111	Dropping Resistance for I101	150 ohms± 5%, 5 w., w.w.	41	Type 5-VWA-150	K56J779
R112	Audio Attenuator	15,000 ohms±10%, 1/2 w., carbon insulated	28	Type BT-1/2	M31J707-76
R113	Headphone Shunting Resistor	3,900 ohms±10%, 1/2 w., carbon insulated	28	Type BT-1/2	M31J707-69
R114	Headphone Shunting Resistor	Same as R113			
R115	Voltage Dropping Resistor	5 ohms±10%, 25 w., w.w.	59	Per GE Dwg.	K56J514-1
		SWITCH			
S101	ON-OFF Power Switch	S.P.S.T. Toggle, 3 amp. 250 v. a-c 1" x 1 17/32" x 17/32"	343	#8280	K56J677
		TRANSFORMERS			
T101	Input Transformer	Turns ratio total sec. to total primary 27.5 to one. Open circuit total sec-	56	#8281	K56J821

TABLE I—PARTS LIST FOR THE 20 N-I WIRE RECORDER (CONTINUED)

Symbol Designation	Function	Description	Mfgr.	Mfgr.'s Designation	G.E. Dwg. and Part No.
		TRANSFORMERS -Continued-			
T101	Input Transformer	(c o n t i n u e d) ondary impedance 23000 ohms min. measured at 1.5 v. 60 cycles. Secondary d-c winding resistance (over-all); resistance 3250 ohms ± 25%. Primary and Secondary Hi-pot. Test 500 v. r.m.s.	56	#8281	K56J821
T102	Output Transformer	Primary D-C Winding Resistance (over-all) 130 ohms ± 15%. Secondary D-C Winding Resistance (over-all) 415 ohms ± 20%, Open-circuit primary impedance (term. #1 and 3), 3000 ohms, 10 volts 60 cps with 3 ma. d-c in winding. Over-all winding turns ratio is: To term. 4-5 = 6.35/1.0 To term. 4-6 = 1.78/1.0 To term. 4-7 = 1.00/1.0 Hi-pot. test primary and secondary windings at 500 v. r.m.s.	56	#8282	K56J820
T103	Oscillator Coil	Primary Coil #32ES Wire, 279 turns, tapped 55, winding--universal 3/8 cam. 6.7 ohms d-c at 20°; Secondary Coil #38 E wire, 390 turns Winding Universal 3/8 com., resistance 50 ohms d-c at 20°.	137	Per GE Dwg.	K56J844-G1
		VACUUM TUBES			
V101 V102	Push-Pull Amplifier Tube Oscillator Tube	Type 28D7 Same as V101	471	Type 28D7	DL4W493-148
		SOCKETS			
X101 X102	Tube Socket for V101 Tube Socket for V102	Octal Socket Same as X101	117	#6998	K56J827
		ASSEMBLIES			
Z101	Noise Filter	Line Filter consisting of C109, C111, and L102	137	Per GE Dwg.	K56J932-G1

TABLE II—LIST OF MANUFACTURERS

Code No.	Navy Prefix	Name of Manufacturer	Address
1		P. R. Mallory & Co.	1941 Thomas St., Indianapolis, Ind.
8	CBN	Centralab, Inc.	900 E. Keefe Ave., Milwaukee, Wis.
19		General Electric Co.	Schenectady, New York
28	CIR	International Resistance Co.	1100 Terminal Commerce Bldg., Philadelphia, Pa.
31	CBV	John E. Fast Co.	3123 N. Crawford Ave., Chicago, Ill.
41	CRA	Utah Radio Products	812 Orleans St., Chicago, Ill.
56	CSN	Standard Transformer Corp.	1510 N. Halsted St., Chicago, Ill.
59		Ward Leonard	6 South St., Mt. Vernon, New York
107	CPH	American Phenolic Corp.	1830 S. 54th Ave., Chicago, Ill.
117		Cinch Mfg.	2339 W. Van Buren Ave., Chicago, Ill.
137		General Electric Co.	Bridgeport, Conn.
153		Littelfuse, Inc.	4765 Ravenswood Ave., Chicago, Ill.
198	CG	G. E. Supply Corp.	New York and all Principal U. S. Cities
343	CAE	Cutler - Hammer Inc.	8 West 14th St., New York, N. Y.
471	CHS	Sylvania Electric Products, Inc.	Emporium, Pa.
510		Radiotechnic Laboratory	1328 Sherman Ave., Evanston, Ill.
561		Dunmore Co.	Racine, Wisconsin
605		National Standards	Miles, Michigan

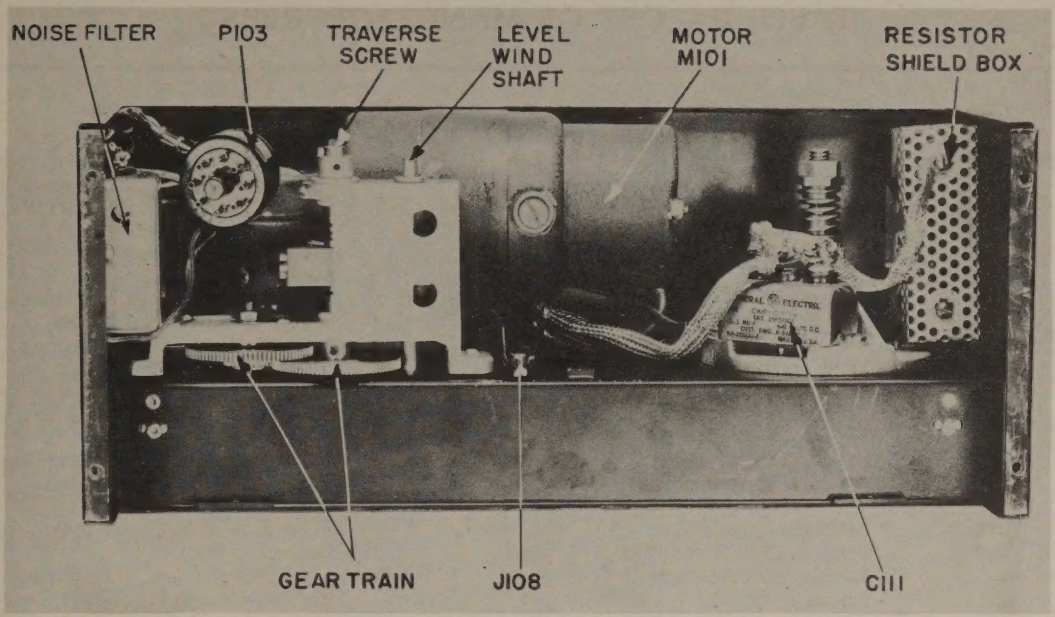

Fig. 3. Rear View Chassis Removed–Showing Motor and Gear Mechanism

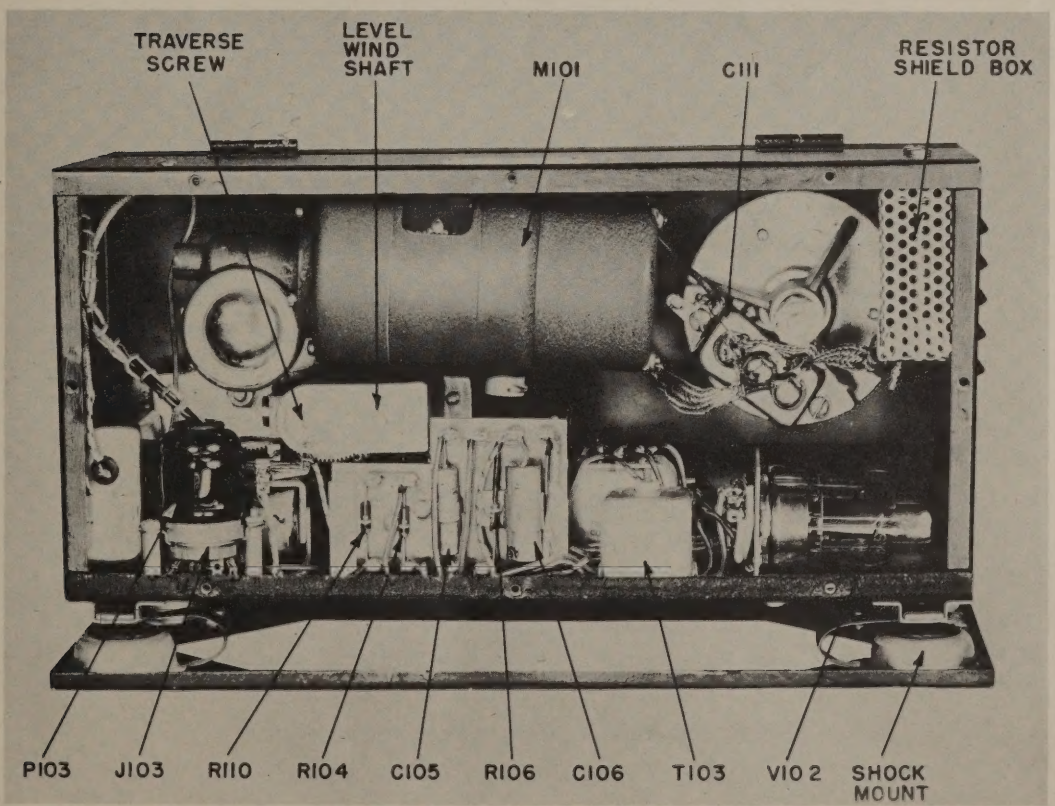

Fig. 4. Rear View, Showing Motor and Terminal Boards

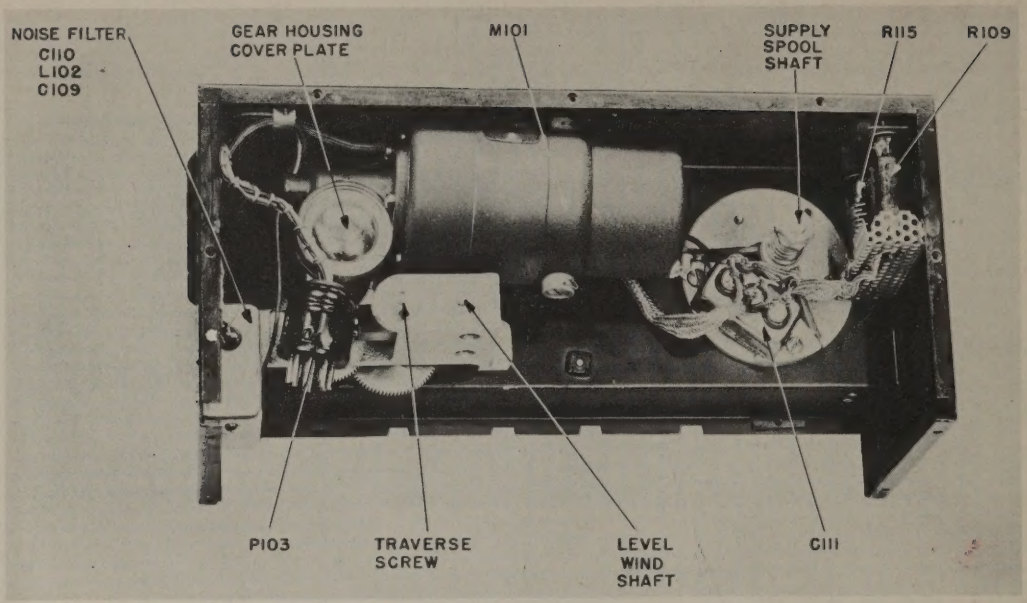

Fig. 5. Bottom View—Chassis Removed—Showing Motor and Wire Transporting Mechanism

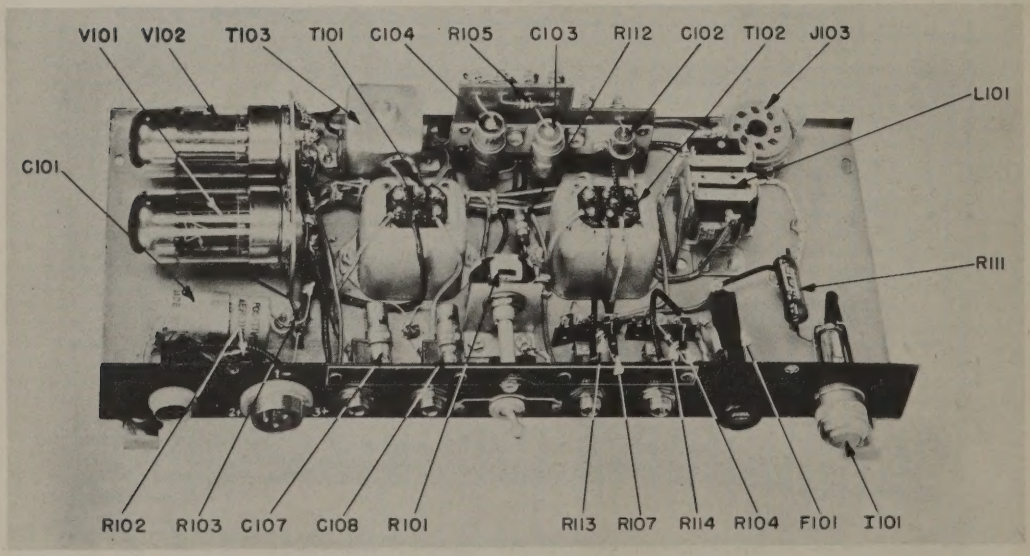

Fig. 6. Top View of Electrical Chassis and Front Panel